

CDM Federal Programs Corporation

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Ms. Caroline Kwan
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Subject: Overview of Esso Soil Gas Survey Conducted on April 5, 1988
through April 23, 1988 in Tutu, St. Thomas, U.S. Virgin Islands;
Work Assignment 648

Dear Ms. Kwan

The purpose of the survey was to assess Esso's role in the contamination of area groundwater. The survey will aid in defining the location and extent of subsurface petroleum hydrocarbon contamination, and define the potential source of the contamination.

Esso Standard Oil SA LTD. has contracted Belgedere and Associates Inc. (BAI) to conduct the soil gas survey. Due to the detection of groundwater contamination in the Tutu vicinity, Esso had agreed to analyze onsite for benzene, toluene, ethylbenzene, and xylene (BTEX) as well as trichloroethylene, tetrachloroethylene, and dichloroethylene (chlorinated hydrocarbons). Two HNu 301 series Gas Chromatographs (GC) were used for the field analyses of the soil gas samples. One GC was equipped with a photo ionization detector (PID) and a flame ionization detector (FID) and a 10% TCEP, Chromosorb PAW 8' x 1/8" ss pack column. This GC was set up for BTEX detection. The other GC, which was set up for chlorinated hydrocarbon detection was equipped with a FID and a 3% SE 30 Chromosorb WAW 6' x 1/8" ss pack column. Although the BAI chemists often verbally reported the presence of chlorinated hydrocarbon peaks during sample analysis, chlorinated hydrocarbon values from only 8 sample locations were reported in the preliminary reduced data. This was insufficient for us to make any conclusions about the extent of chlorinated hydrocarbon contamination in the area.

The first phase of the soil gas survey was done on a grid pattern with 29 sample points and 50 foot centers within and immediately surrounding the service station. The grid was extended based on field judgement to define the extent of contamination. A total of 44 locations were sampled by driving 5/8 inch probes to depths ranging between 2 and 8 feet. Shallow (4') and deep (6-8') samples were analyzed where possible. Soil gas was evacuated from the probe using a battery operated vacuum pump. The soil gas samples were then extracted from the probe at the septum using gas tight syringes.

The lithology as well as man-made obstacles, such as storm drains and building slabs, made it impossible to follow the exact grid as proposed by BAI. For example, several proposed points across Road Number 38 were not tested due to the closeness of the bedrock to the surface.

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A review of the preliminary soil gas data from the Esso Tutu Site was undertaken to establish its validity and applicability.

The major analytical problem encountered during data acquisition was signal noise. The noise could have been from any number of sources including unstable power supply, dirty injector and/or detector, short in cable or grounding problem, column degradation or contamination, and electronic failure within the instrument. The major consequences of the noise are baseline instability, extraneous peaks which may confound peak identification and quantitation, and poor sensitivity.

While generally applicable, the utmost care must be taken in drawing specific conclusions from the data in their preliminary form because:

- o There were several days during which two sets of data were generated on separate instruments for each sample. According to Louis Maldonado (Belgodere & Associates), all of the data are still being evaluated and some preliminary results may be substituted with results from the alternate data set. The changes could significantly affect data interpretation.
- o The work plan stipulates that results will be based on multiple calibration gas analyses from which an average response factor will be calculated for each component. Preliminary data is based on response from a single calibration run. Assuming that representative calibrations were used, use of average response factors should not yield significantly different results. However, given the numerous analytical problems encountered, this assumption may not be correct.
- o For several of the days during which data were collected, the instrument was calibrated and programmed to automatically generate the final calculated result (i.e. identify the chromatographic peak by its presence within a retention time window and apply calibration response factor to the measured peak area). The preliminary data was taken directly from this printout apparently without checking the validity of peak identifications. Peak mis-identification by the instrument can occur even under ideal analytical conditions and is much more likely when the baseline is noisy. One such mis-identification was found during this review (resulting in a value for ethyl benzene + M,P-xylene of 0.001 instead of 0.054 ppm) and others are likely to be found and corrected during generation of the final data.
- o Each sample was analyzed at least twice and up to four times in an effort to generate reproducible results. In many cases, one of the four analyses yielded a significant "hit" while the other three showed no evidence of the compound. This strongly suggests the possibility of false negatives, which could drastically alter the interpretation of the overall data set (specifically, the drawing of plumes). It is not clear whether the potential for false negatives is inherent in the method or is a consequence of the analytical problems cited. It may be a combination of the two.

The following should be considered when interpreting the final data set:

- o Due to analytical problems, two GCs, three different detectors (one PID, two FID) and at least three different columns were used. As long as each was properly calibrated, there should be reasonable continuity in the results as a whole. However, there are at least two populations of data because a switch was made to a different type of column (due to lack of backup) with different chromatographic characteristics. The result, at a minimum, is discontinuity in the ethyl benzene and xylene data.
- o The "Total Hydrocarbon" values reported were generated by applying an average response factor of the calibration gas constituents to the total (combined) peak area from each chromatogram. These values are grossly affected when extraneous peaks are detected due to signal noise. Depending on what this value is to be used for, it might be better to simply sum the individual compound values.
- o There may be aspects of the methodology itself that yield questionable results (such as false negatives discussed above). One possible aspect is the condition under which the sample gas is drawn into the syringe. If the pressure of the volume being sampled is significantly below one atmosphere, the sample could be diluted by an unknown amount, thus yielding erroneously low results. Dilution would occur as air leaked into the sampling system across the pressure gradient. If the system is leaked-tight, air would rush into the syringe needle once it was removed from the sampling system until the pressure of the sample gas in the syringe was one atmosphere.

At the start of the Esso soil gas survey, it was agreed to use the same background value that was used for the Texaco soil gas survey (< 1 ppb). The low end standards (ppb range) were not available for the GC calibration, but it was thought possible by Esso that by diluting the standards they could calibrate the GCs such that they get order of magnitude readings down to 2 ppb. Due to the numerous analytical problems encountered as the project progressed, and the time factors involved, it was decided by Esso, BAI, EPA, DPNR, and CDM FPC that a detection limit of 1 ppm was adequate to define the extent of contamination for the purpose of the soil gas phase of the project.

It has been determined that the data received from BAI is generally applicable to the stated purpose of establishing the order of magnitude of BTEX present in the soil gas to the detection limit of about 1ppm by volume. The total BTEX values were used to define the extent of contamination (Figure 1). It must be stressed that the conclusions have been made based on data in its preliminary form. All of the data will be evaluated and changes by Esso could significantly affect data interpretation.

The following observations and subsequent conclusions can be made based on the information obtained during the Tutu Esso Soil Gas Survey. Total BTEX soil gas values were reported in excess of 1000 ppm in the southern portion of the Esso property adjacent to the petroleum underground storage tanks. This area of high BTEX soil gas contamination extends to the southwest of the Esso property into the Four Winds Plaza parking lot (figure 1). The concentration of total BTEX is reduced from above 1000 ppm to below 1 ppm with increased distance from the southern portion of the Esso property, upgradient as well as down gradient. Unfortunately, the full extent of the soil gas contamination (i.e. values equal or below the agreed upon background level) around the Esso station was not determined due to the relatively high detection limit of 1 ppm. However, based on the soil gas survey results and plotting the plume of petroleum hydrocarbon contamination, it seems apparent that Esso is responsible for a product release and the contamination of soil gas in at least the immediate vicinity of its service station. The results of Tutu Texaco Soil Gas Survey indicate that Texaco is also responsible for a product release and contamination of soil gas in at least the immediate vicinity of its service station.

If Esso is planning an excavation of their underground storage tanks as part of their service station maintenance program, it is our recommendation that soil samples be collected and analyzed as part of this excavation. After the tank excavation and sampling, CDM FPC recommends a joint investigation between Esso and Texaco to further define the nature and extent of the contamination in the Tutu Wellfield Area. The joint investigation will make all subsequent activities more cost efficient for all involved parties. The first phase of the investigation should consist of a subsurface investigation involving the installation of groundwater monitoring wells, split spoon soil boring and analyses, and groundwater collection and analyses. EPA at this point should consider a time schedule to implement the PRP committee and commence with the next phase.

Sincerely,

CDM Federal Programs Corporation


Scott Graber
TES III Work Assignment Manager

cc: Jose Fonte, EPA Caribbean Division
Greg Rhymer, DPNR
Colleen Connor, ORC
NYC File

PRELIMINARY RESULTS OF THE ESSO SOIL GAS SURVEY AT THE TUTU AREA

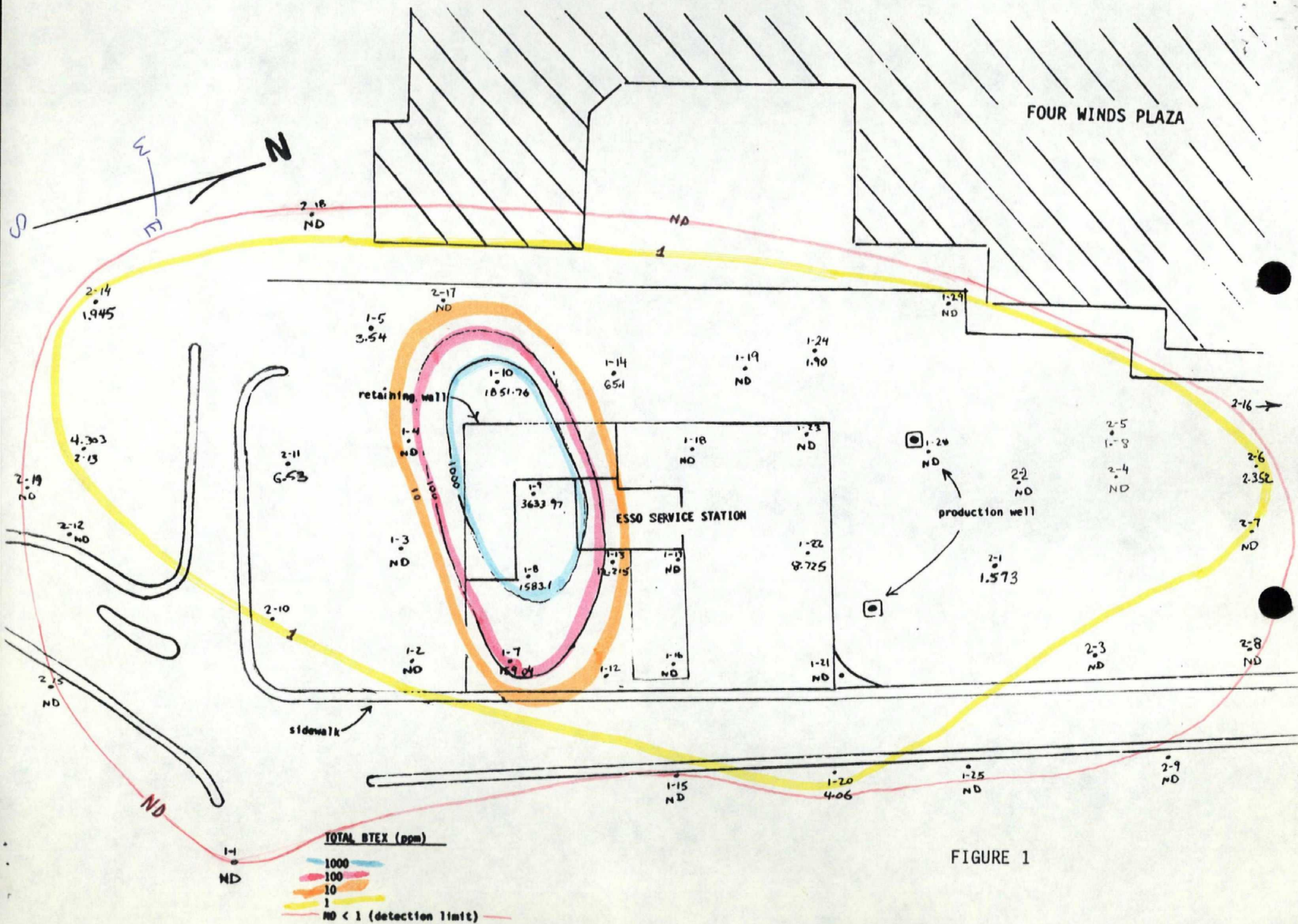


FIGURE 1